The Naval Research Enterprise

“manhattan” Program to

Counter IEDs

Purpose – "manhattan" Program

- **Develop a long-term <u>Basic Research</u> program to develop counter-IED capabilities**
  - **Establish/nurture a multidisciplinary counter-IED S&T community**
  - **Focus on research to break the "Kill Chain" as early as possible**
  - **Ensure work is complementary to other U.S. and allied efforts**
  - **Foster collaboration, where possible, with allies (UK principal focus) and NATO**

Background

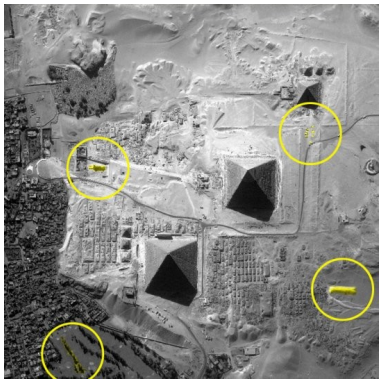
- **<u>October 2004</u>: Secretary England & RADM Cohen meet … Result: Establish program to counter IED threats.**
- **<u>January 2005</u>: Kickoff meeting at Naval Research Laboratory … CNR directs <u>10% of NRL core funding</u> toward this effort**
- **<u>March 2005</u>:**
  - **CNR re-directs FY05 funding to jump start extramural efforts.**
  - **Meeting among SECNAV, Director OSTP, Director NSF, President-National Academy of Engineering, & CNR.**
- **<u>June 2005</u>: National Academy of Engineering (NAE) hosted Counter-IED workshop in DC.**
- **<u>July 2005</u>:**
  - **Naval-Industry Partnership Conference – Focus on GWOT**
  - **Community-wide Basic Research BAA issued**
- **<u>August 2005</u>: Initial grants awarded to UARCs**
- **<u>September 2005</u>: Over 450 white papers received in response to BAA**

Countering the IED Threat
Examine IED Delivery / Kill Chain to Develop Systematic Countermeasures

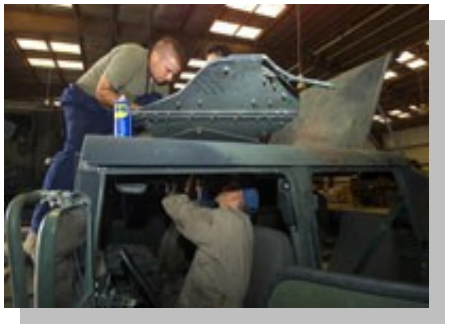
Obtain Funds

Develop Organization

Gather & Provide Material

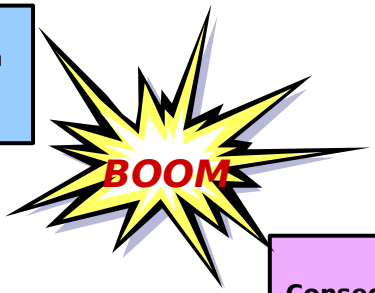


Improvise CONOPS/ Tactics/ Devices

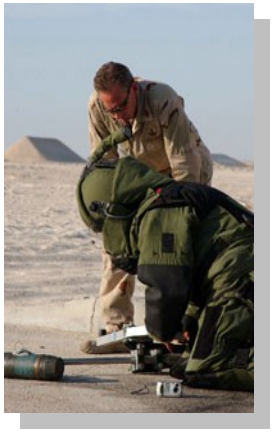


Plan Attacks

Perform Attacks



Consequence Management



Attribution

Counter-IED Strategic Initial Research Approach

STAGE	Predict	Detect	Prevent	Neutralize	Mitigate
CAPABILITIES	• HUMINT • PSY OPS • Behavioral Pattern Recognition • ISR / COMMS • Forensic Analysis	• Sensors • Stand-off Detection • False Alarm Reduction • Pattern Recognition • Remote Surveillance	• Deny enemy comms • Deny enemy free movement • Deny enemy ISR • Control access to materials • Jamming	• Render IED safe • Disposal • Controlled Detonation • Forensic collection • Enemy Interdiction	• Blast resistance • Blast containment • First responders • Medicine • Information Operations
RESEARCH THRUSTS	• Psychology & Sociology of Terrorists • Information Management • Pattern Recognition • Artificial Intelligence • Explosive Characteriz...	• Sensor Technologies • Signal Processing • Data Fusion • Pattern Recognition • Autonomous System Technologies	• RF Communications • Non- Lethal Weapons • Information Management • Artificial Intelligence	• Chemisty /Physics of Explosives • Energy-based Weapons • Autonomous System Technologies • Tagging / Marking	• Protective Structures • Armor • Biomedical • Knowledge Management • Information Technology

Breakthroughs Occur "At the Seams"

Current Efforts in DoD What Others are Doing

- **DEPSECDEF**
  - National Laboratory Challenge
- **Joint IED Defeat Task Force**
- **Army/USAF efforts**
- **Combating Terrorism Technology Task Force (CTTTF)**

Harvesting the Low Hanging Fruit
(From previous S&T Investments)

Current DoD Focus on

- **Near to mid-term defeat/destruction of threat**
- **Accelerating programs to acquisition**
- **Adapting & exploiting available 6.2/6.3/6.4 technologies**

Current Harvest Nearly Complete

DoN Approach

- **Naval Research Laboratory**
- **University Affiliated Research Centers (UARCs)**
  - APL Johns Hopkins University
  - ARL Penn State University
  - ARL University of Texas
  - APL University of Washington
  - University of Hawaii (being established as UARC)
- **Broader S&T Community**
- **International Participation**

Intramural Efforts = $15M / Yr

Extramural Efforts = $15M / Yr

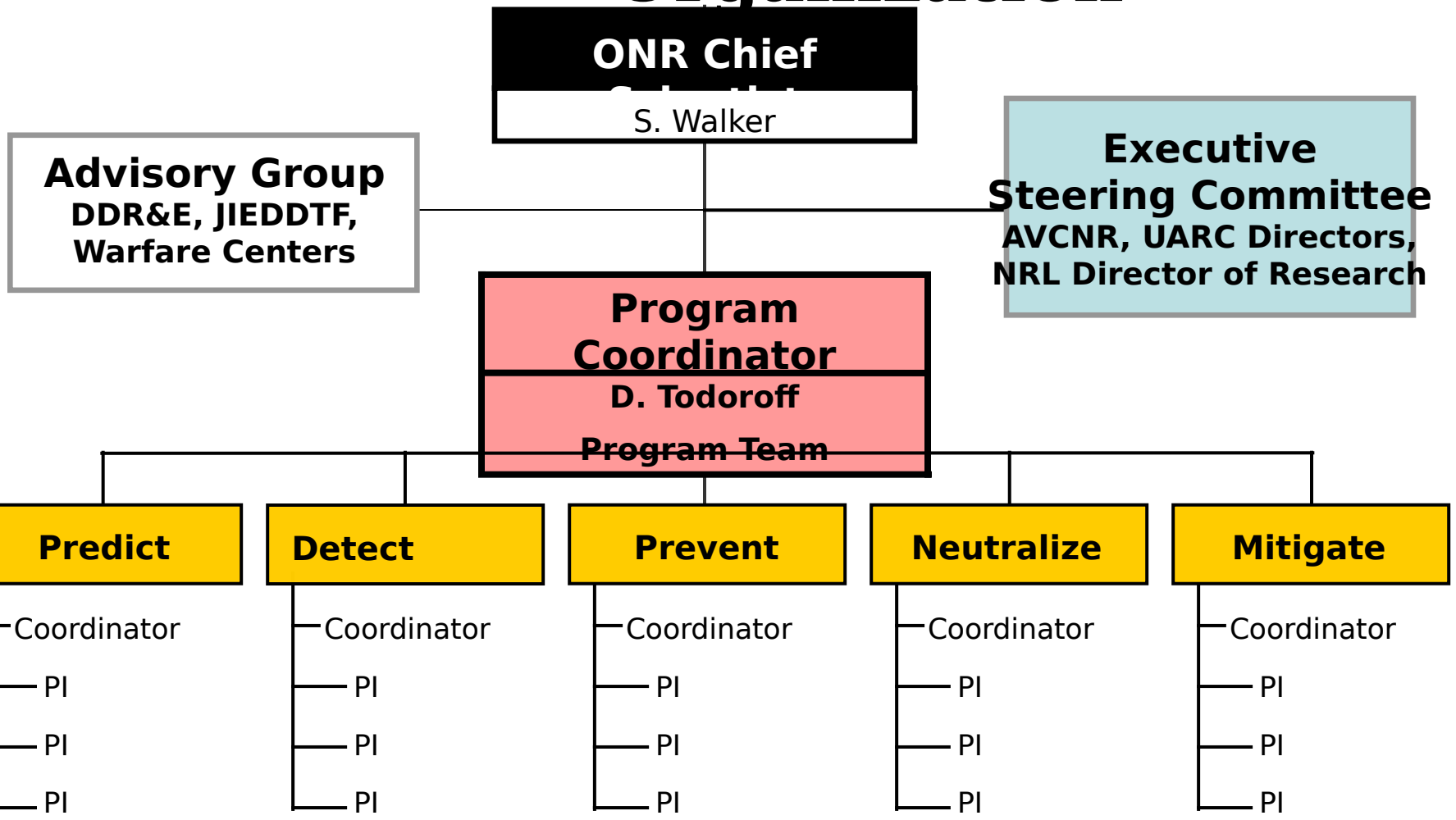
Complementary, not Competitive

Focus on

- **Long-term investment in Basic Research / phenomenology**
- **Multi-disciplinary … Nothing off table**

Build a Multidisciplinary Community

Navy Counter-IED Organization



Major Outreach Efforts

- Joint IED Defeat Task Force
- Director, Office of Science and Technology Policy
- Director, Defense Research and Engineering
- Defense Threat Reduction Agency
- Department of Homeland Security
- Department of State
- Commandant of the Marine Corps
- DOE – Laboratory Coalition
- Army and Air Force Research Organizations
- President, National Academy of Engineering
- Director, National Science Foundation
- UK Ministry of Defence
- UK Royal Academy of Sciences

UK Interactions

- **ONR Chief Scientist briefings for:**
  - **Lord Alec Broers, Chairman S&T Committee, House of Lords and President of the Royal Academy of Engineering**
  - **Sir Keith O'Nions, Director General, UK Research Councils**
  - **Ministry of Defence**
  - **MI5**
  - **Home Office**
  - **Director - Royal United Services Institute (RUSI)**

- **CNR and ONR Chief Scientist invited speakers for RUSI conference on IEDs on 4 November**

- **Selected DoN efforts will be coordinated with members of UK MOD**

Counter-IED NRL Program

Long-term fundamental research to counter advanced IEDs including Chemical, Biological, and Radiological kill mechanisms

IED CATEGORY			
Predict	**Detect**	**Neutralize**	**Protect**
NRL RESEARCH AREA PAYOFFS			
• Automatically recognize facial features of known terrorists • Detect and read hidden terrorist communications in images and under speech	• Very high sensitivity, low false alarm rate chemical, biological, radiological, and electromagnetic sensors to detect IEDs • Tagging technologies to remotely detect or track IED components, transport vehicles, or people • Detection of IED signatures induced by a remote stimulation source • High resolution sensors that discriminate between IEDs, suicide bombers, and background clutter • Sensors to detect underwater attacks of ships and structures	• Distributed autonomous sensor networks to detect and report on terrorist activities and IED-related actions • Understanding of advanced explosives technologies (e.g. use of metal nano particles) and how to defeat them • Miniature jamming devices for A/C, ground vehicles, and personnel that prevent remote activation of IEDs • Long-range detection and defeat of RF devices used to communicate with terrorists or IEDs	• Thin ultra-high strength transparent armor • Advanced structural human models to understand and minimize blast effects • Materials and fabric coatings that automatically destroy and defeat contaminant/toxins • Multi-fold mitigation of blast effects using water mist systems • Elastomeric armor coatings that reduce deformation and prevent rupture of armored vehicles

Counter-IED UARC Program

IED CATEGORY			
Predict	**Detect**	**Neutralize**	**Protect**
• Investigate new statistical learning architectures that can recognize patterns in sparse data • Develop reasoning algorithms to enable the discernment of patterns of behavior indicative of hostile activity • Develop automated approaches to anomalous behavior detection that can identify precursors to IED development and/or deployment. • Explore bioforensic approaches to establish the place, origin, and transport history of IEDs or the remains of exploded IEDs	• Develop a physics based model of nonlinear acoustic surface waves for IED detection. • Investigation of ultra-wideband (THz) and super resolution imaging for detection of IEDs • Develop a dynamical model and study the dynamic behavior of a human delivery system for IEDs (suicide bomber)	• Development of multiscale analysis approaches to predict performance of nanomechanical fragmentation protection systems • Investigate the detonation of energetic materials and their interaction with materials designed to mitigate explosive effects	• Investigate/demonstrate organic/nanowire chemical sensors for IED detection • Investigate non-invasive cauterization (acoustic energy) for stopping uncontrolled bleeding from major arteries

Counter-IED Timeline

October 2005:

- **Complete Review of White Papers**
- **Encourage Full Proposals for White Papers of Value**

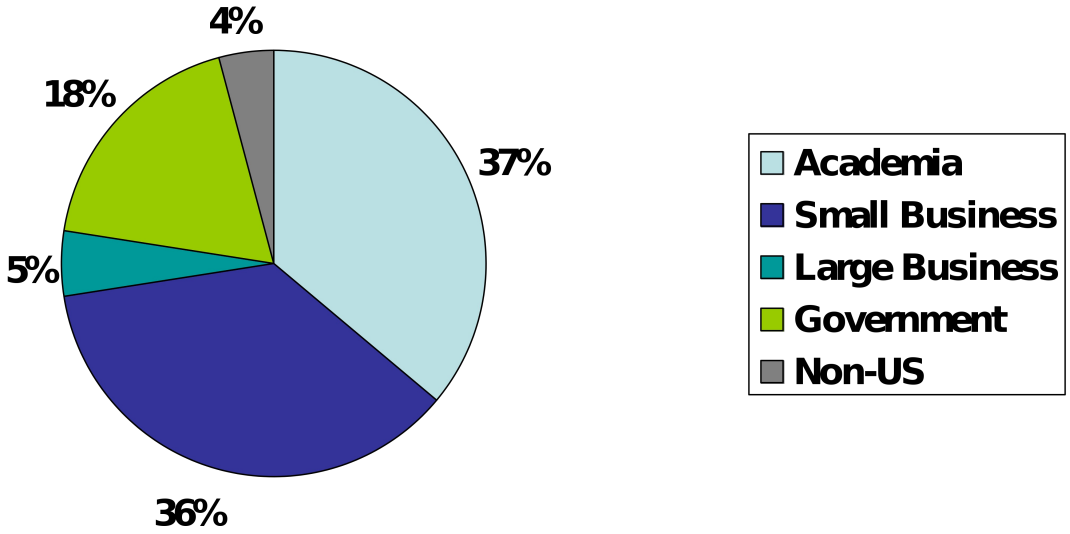
November 2005:

- **NAE Initiate Workshop Focusing on Prediction / Pre-detonation / Mitigation**
- **NAE conduct informational meeting for Academic Research VPs**
- **UK Royal United Services Institute (RUSI) Conference.**

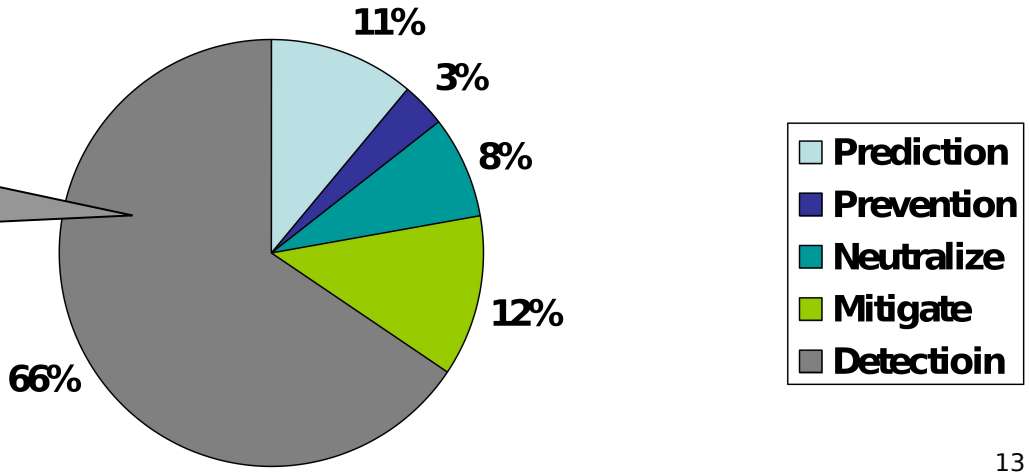
January 2006:

- **Award Grants under BAA**

BAA White Paper Distribution Statistics



Detection (290 Papers)	
Acoustics	10
Nuclear	14
Optical	70
RF / Radar	29
Thz & mm Wave	30
Trace Detection	43
Other	36



Observations

- **Strong interest within S&T community**
  - **Exceptional response to BAA**
  - **Many offeror's have formed strong multidisciplinary teams**
  - **Strong academic, industry, government partnerships**
  - **Not just the usual performers**
- **Moving up the IED kill chain presents great challenge**
  - **Majority of offeror's still focused on detection <u>AFTER</u> emplacement…mitigation of effects**
    - ✓ **Partnership with NAE, NSF, and UK will help focus efforts up the "kill chain"**
  - **Need to establish community data set for prediction efforts**
- **Must stay informed/connected to other counter IED efforts both U.S. and international**

Summary

- **Develop/maintain sustained long term Basic Research Effort**
- **Focus on research to break “kill chain” as early as possible … Couple behavioral sciences with technical sciences**
- **Goal: Develop collective strategy to engage & nurture multi-disciplinary community of Government, academic, and industry researchers**

B A C K U P

IED Technology Phase I Awards

Advanced Ceramics	**UAV and Ground Vehicle Electromagnetic Sensor System, to protect Convoys**
All Optronics	**Optical Change Detection System, with fluorescent markings**
Spectra Research	**Flash Ladar Sensor**
Physical Optics	**Roadside X-Ray**
Nova Spectra	**CMOS-MEMs focal plane array for IR**
Nomadics	**Detection of Trace Chemicals**
Nomadics	**Sensors with Small Robotic Vehicles**
For3D.inc	**Optical change detection system integrated to human vision**
Nanotherapeutics	**HMTD and TATP detection with surface acoustic wave array**
Menon and Associates	**Vacuum Rapid Collection and Analysis of particulate samples**
Triton Systems	**Low Cost Explosive Vapor micro system detection system**

IED Technology Phase II Awards

Advanced Ceramics	**UAV and Ground Vehicle Electromagnetic Sensor System, to protect Convoys**
For3D.inc	**Optical change detection system integrated to human vision**
Physical Optics	**Roadside X-Ray**
Under Negotiation	
Nanotherapeutics	**HMTD and TATP detection with surface acoustic wave array**
Nomadics	**Detection of Trace Chemicals**
Nomadics	**Sensors with Small Robotic Vehicles**